The Wilson Journal of Ornithology 119(2):267–270, 2007

Diet of Black and Turkey Vultures in a Forested Landscape

Neil E. Kelly,[1] Dale W. Sparks,[2,4] Travis L. DeVault,[3] and Olin E. Rhodes, Jr.[3]

ABSTRACT.—Black (*Coragyps atratus*) and Turkey (*Cathartes aura*) vultures feed heavily on carrion from domestic animals in agricultural landscapes. A recent study indicates vultures at a forested site in South Carolina had much larger home ranges than those residing in agricultural landscapes. Vulture home ranges at the forested site contained few residential or agricultural lands, and we hypothesized that vultures at that site fed extensively on wild carrion. We collected 65 regurgitated pellets from a communal night roost between 16 October 2000 and 9 April 2002 to test this hypothesis. The pellets contained undigested parts of consumed carrion including hair, bone, scales, and claws. Wild mammals, particularly white-tailed deer (*Odocoileus virginianus*), common raccoons (*Procyon lotor*), Virginia opossums (*Didelphis virginiana*), and striped skunks (*Mephitis mephitis*), were common food items. The only domestic animal recovered (in two pellets) was the house cat (*Felis catus*). This study supports the observations that carrion resources affect distributions and movement patterns of Black and Turkey vultures. *Received 15 August 2005. Accepted 28 July 2006.*

Black (*Coragyps atratus*) and Turkey (*Cathartes aura*) vultures feed heavily on carrion from domestic animals in landscapes dominated by agriculture (Yahner et al. 1986, Coleman and Fraser 1987, Prior 1990, Yahner et al. 1990, Hiraldo et al. 1991). However, few data are available concerning diets of vultures in primarily non-agricultural landscapes (Thomaides et al. 1989). The available evidence suggests that diets of these scavengers vary across their geographic ranges (Thomaides et al. 1989, Prior 1990, Yahner et al. 1990, Hiraldo et al. 1991) and across seasons (Yahner et al. 1986, Coleman and Fraser 1987). DeVault et al. (2004b) observed vulture home ranges at the Savannah River Site (SRS) in South Carolina were essentially twice the size of those reported from an agricultural area in southern Pennsylvania and northern Maryland (Coleman and Fraser 1989). Home ranges at the SRS contained little residential or agricultural land, and DeVault et al. (2004b) hypothesized that vultures at SRS had to travel greater distances to find carrion and fed primarily on wild carrion.

An understanding of vulture diet composition and movement patterns is of critical importance to the aviation industry because Black and Turkey vultures are among the species most likely to collide with military aircraft operating at low altitudes (DeVault et al. 2005). Vultures are considered to be second only to deer in risk posed to civil aviation with 67% of collisions resulting in damage to the aircraft (Dolbeer et al. 2000). Telemetry evidence suggests that availability and distribution of carrion are important factors affecting vulture movement, and may influence the potential for catastrophic collisions with aircraft (DeVault et al. 2005). The objective of our study was to describe diets of Black and Turkey vultures roosting at SRS and to relate their diets to vulture movement patterns (DeVault et al. 2004b, 2005).

METHODS

Study Site.—The SRS is a 78,000-ha limited access nuclear production and research facility owned and operated by the U.S. Department of Energy on the Savannah River near Aiken, South Carolina. Approximately 64% of SRS is managed as commercial pine (*Pinus* spp.) plantations by the U.S. Forest Service with an additional 15% of the land classified as bottomland hardwood (Workman and McLeod 1990). Several industrial areas occur throughout the site and there are no agricultural or residential areas within the site boundary.

Collection of Pellets.—Vultures regurgitate indigestible portions of their meals (i.e., hair, bone, and feathers) as pellets (Kirk and Moss-

[1] Department of Geography, Geology, and Anthropology, Indiana State University, Terre Haute, IN 47807, USA.

[2] Department of Ecology and Organismal Biology, Indiana State University, Terre Haute, IN 47809, USA.

[3] Department of Forestry and Natural Resources, Purdue University, 195 Marsteller St., West Lafayette, IN 47907, USA.

[4] Corresponding author; e-mail: dsparks@isugw.indstate.edu

man 1998, Buckley 1999). We collected 65 fresh pellets (ranging from 8–16 pellets/trip) between 16 October 2000 and 9 April 2002 from a communal night roost for hundreds of Black and Turkey vultures on the roof of the R-Reactor, an abandoned nuclear reactor. We initially planned to collect samples at regular intervals (i.e., quarterly) during a 2-year period but, because of security concerns, we were only able to make six trips to one portion of the reactor's roof. Observations during the trips suggested that ~70% of the vultures present were Black Vultures. Thus, our sample likely included pellets from both species.

Identification of Samples.—We treated each pellet as a separate sample. Upon collection, each pellet was placed into a plastic bag, sealed, and transported to Indiana State University. Pellets were soaked overnight in sealed jars to loosen the material and dissected in a glass Petri dish for analysis. Hair identifications were made using a combination of published keys (Mathiak 1938, Williams 1938, Mayer 1952, Stains 1958, Cotheran et al. 1991) and direct comparisons with specimens in the vertebrate collections at Indiana State University, Purdue University, and the Indiana State Museum. Feathers, bones, claws, and skin fragments were compared directly to samples obtained from museum collections and local farms. Initial, coarse identifications were made using physical characteristics of hairs under a 10–35× zoom dissecting microscope (Stains 1958). Identifications were verified by comparing individual hairs to known samples using a 40–1,000× binocular comparison microscope.

We report the frequency of food items and a modified estimate of average percent volume. Percent volume has been criticized (Coleman and Fraser 1987) because not all food items are equally digestible. However, we see no reason this argument should apply to fine keratinized structures. Thus, we removed large structures (bones, claws, teeth) and non-animal material from the Petri dish and visually estimated the percent hair, feathers, and scales belonging to each taxa for each pellet. Some species were only detected from larger remnants, but the value of using modified percent volume is that it provided an important tool in distinguishing major food items from those that are frequently, but incidentally ingested (i.e., vulture down).

TABLE 1. Food items of Black and Turkey vultures from the Savannah River Site in South Carolina.

Taxa	Frequency (%)	Volume (%) ($\bar{x} \pm$ SD)
Metazoa	98	
Insecta (Formicidae)	2	
Reptilia (Colubridae)	2	Trace
Aves	34	4 ± 13
Cathartidae	34	4 ± 13
Meleagris gallipavo	2	
Mammalia	98	96 ± 14
Odocoileus virginianus	42	30 ± 44
Procyon lotor	37	32 ± 45
Didelphis virginiana	18	17 ± 37
Mephitis mephitis	15	13 ± 33
Felis catus	3	2 ± 13
Scalopus aquaticus	2	0
Sciurus niger	2	2 ± 13
Sylvilagus floridanus	2	1 ± 6
Plantae	85	
Poaceae	37	
Unknown	29	
Quercus leaves	15	
Thatch	3	
Juniperus virginiana	2	
Leaf litter	2	
Unidentified twig	2	
Unidentified seeds	2	
Non-biological material	11	
Soil	6	
Plastic	6	
Polystyrene	2	
Paper bag	2	

RESULTS

Wild mammals, particularly white-tailed deer (*Odocoileus virginianus*, 42% frequency), common raccoons (*Procyon lotor*, 37%), Virginia opossums (*Didelphis virginiana*, 18%), and striped skunks (*Mephitis mephitis*, 15%), were common food items (Table 1). The only domestic/feral animal recovered was the house cat (*Felis catus*), recovered from two pellets. Other mammals present in the diet included eastern mole (*Scalopus aquaticus*, 2%), fox squirrel (*Sciurus niger*, 2%), and eastern cottontail (*Syvilagus floridanus*, 2%). Non-mammalian prey was rare, but some pellets included Wild Turkey (*Meleagris gallipavo*, 2%), a snake (cf. Family Colubridae, 2%), and ants (Formicidae, 2%). Vulture down (34%) was found in many pellets, but because it occurred in low percent volumes (mean = 4%), we suspect it was ingested during preening. Plant material (85% frequency)

composed a minor portion of the volume of most pellets. Some anthropogenic materials were present, including plastic, paper bags, and polystyrene.

DISCUSSION

Vultures at SRS fed almost exclusively on wild carrion in our study. Feral cats are known to occur at SRS (Cotheran et al. 1991) and were likely the source of hair recovered from two pellets. Previous studies in both agricultural and relatively pristine landscapes (Paterson 1984, Yahner et al. 1986, Coleman and Fraser 1987, Thomaides et al. 1989, Prior 1990, Yahner et al. 1990, Hiraldo et al. 1991) suggested that insectivores and rodents would constitute an important component of the diets. However, the only small mammal in the pellets was a young (based on skeletal morphology) eastern mole (*Scalopus aquaticus*). Black and Turkey vultures at SRS were photographed feeding on mouse-sized carcasses experimentally placed throughout SRS during the same time period (DeVault et al. 2004a). Thus, we were surprised that small mammals were not a common component of the diet.

Three observations led us to suspect most of the carrion consumed by vultures during this study was obtained from road-killed animals. First, the diet of these vultures was dominated by medium-to-large-sized mammals (98% frequency, 96% volume), which were commonly observed dead along the roads (T. L. DeVault, unpubl. data). Second, 37% of the pellets contained grass and the only grass we could identify was Bermudagrass (*Cynodon dactylon*), which is commonly planted along roadways at SRS. Vegetation consistent with scavenging in woodlands (oak leaves and leaf litter) was present in only 17% of the pellets. Woodland vegetation is adjacent to roadways in this heavily forested landscape. Third, anthropogenic materials (plastic sandwich bags, brown paper sacks, and polystyrene) were present in several pellets; we suspect this represents road-side trash. Our data provides little insight into the presettlement diets of vultures in the study area as they relied heavily on road-killed animals for food.

Causes of animal mortality and by extension, type, amount, and availability of carrion resources available to vultures and other scavengers, vary widely across regions (DeVault et al. 2003). Our study suggests that diets (i.e., wild animals) of vultures at SRS differ markedly from those in agricultural regions in southern Pennsylvania and northern Maryland where domestic animals dominate the diet (Coleman and Fraser 1987). Black and Turkey vultures apparently can adjust foraging behaviors to best exploit available carrion resources. This adaptability has most likely contributed to recent range expansions of both species into the northeastern United States (Rabenold 1989). Future human-induced alterations to availability and type of carrion resources accessible to vultures (caused either by changes in land use, agricultural practices, or by increases in road kill) likely will continue to influence vulture distributions in the United States and elsewhere.

Type and availability of carrion at a local scale can also influence movement patterns of individual vultures. For example, vultures at SRS exhibited much larger home ranges (DeVault et al. 2004b) and flew more often and at higher altitudes (DeVault et al. 2005) than vultures in agricultural regions in southern Pennsylvania and northern Maryland (Coleman and Fraser 1989). Continued development of bird avoidance strategies by aircraft operators (e.g., Lovell and Dolbeer 1999) should consider how the amount and availability of carrion resources contributes to differences in vulture flight behaviors among regions (DeVault et al. 2005). Similarly, managers whose goal is control vulture populations must understand the potential of their activities to change the behaviors of individual vultures. Future inter-regional studies of vulture ecology (e.g., roost dynamics) should provide a better overall understanding of vulture biology and, ultimately, improved management strategies for vultures.

ACKNOWLEDGMENTS

We thank B. D. Reinhart for help collecting pellets, and I. L. Brisbin, Jr., R. L. Richards, and J. O. Whitaker, Jr. for logistical support. R. N. Williams allowed us to obtain hair samples from specimens housed in the Purdue University collection of mammals. The manuscript was improved by comments by J. D. Fraser and two anonymous reviewers. An earlier version of this manuscript was submitted by N. E. Kelly as a senior thesis (under the direction of S. M. Phillips) in the Department of Geography, Geology, and Anthropology at Indiana State University. This project was funded by contract DABT63-96-D-0006 between Pur-

due University and the U.S. Air Force Bird/Wildlife Aircraft Strike Hazard Team, and the Environmental Remediation Sciences Division of the Office of Biological and Environmental Research, U.S. Department of Energy, through Financial Assistance Award DE-FC09-96-SR18546 to the University of Georgia Research Foundation.

LITERATURE CITED

Buckley, N. J. 1999. Black Vulture (*Coragyps atratus*). The birds of North America. Number 411.

Coleman, J. S. and J. D. Fraser. 1987. Food habits of Black and Turkey vultures in Pennsylvania and Maryland. Journal of Wildlife Management 51: 733–739.

Coleman, J. S. and J. D. Fraser. 1989. Habitat use and home ranges of Black and Turkey vultures. Journal of Wildlife Management 53:782–792.

Cotheran, E. G., M. Smith, J. Wolff, and J. Gentry. 1991. Mammals of the Savannah River Site. SRO-NERP-21. Savannah River Ecology Laboratory, Aiken, South Carolina, USA.

DeVault, T. L., I. L. Brisbin, Jr., and O. E. Rhodes, Jr. 2004a. Factors influencing the acquisition of rodent carrion by vertebrate scavengers and decomposers. Canadian Journal of Zoology 82:502–509.

DeVault, T. L., O. E. Rhodes, Jr., and J. A. Shivik. 2003. Scavenging by vertebrates: behavioral, ecological, and evolutionary perspectives on an important energy transfer pathway in terrestrial ecosystems. Oikos 102:225–234.

DeVault, T. L., B. D. Reinhart, I. L. Brisbin, Jr., and O. E. Rhodes, Jr. 2004b. Home ranges of Sympatric Black and Turkey vultures in South Carolina. Condor 106:706–711.

DeVault, T. L., B. D. Reinhart, I. L. Brisbin, Jr., and O. E. Rhodes, Jr. 2005. Flight behavior of Black and Turkey vultures: implications for reducing bird-aircraft collisions. Journal of Wildlife Management 69:601–608.

Dolbeer, R. A., S. E. Wright, and E. C. Cleary. 2000. Ranking the hazard level of wildlife species to aviation. Wildlife Society Bulletin 28:372–378.

Hiraldo, F., M. Delibes, and J. A. Donazar. 1991. Comparison of diets of Turkey Vultures in three regions of northern Mexico. Journal of Field Ornithology 62:319–324.

Kirk, D. A. and M. J. Mossman. 1998. Turkey Vulture (*Cathartes aura*). The birds of North America. Number 339.

Lovell, C. D. and R. A. Dolbeer. 1999. Validation of the United States Air Force bird avoidance model. Wildlife Society Bulletin 27:167–171.

Mathiak, H. A. 1938. The key to the hairs of the mammals of southern Michigan. Journal of Wildlife Management 2:251–268.

Mayer, W. V. 1952. The hair of California mammals with keys to the dorsal guard hairs of California mammals. American Midland Naturalist 48:480–512.

Paterson, R. L. 1984. High incidence of plant material and small mammals in the autumn diet of Turkey Vultures in Virginia. Wilson Bulletin 96:467–469.

Prior, K. A. 1990. Turkey Vulture food habits in southern Ontario. Wilson Bulletin 102:707–710.

Rabenold, P. P. 1989. Black and Turkey vultures expand their ranges northward. Eyas 2:11–15.

Stains, H. J. 1958. Field key to guard hair of middle western furbearers. Journal of Wildlife Management 22:95–97.

Thomaides, C., R. Valdex, W. H. Reid, and R. J. Raitt. 1989. Food habits of Turkey Vultures in west Texas. Journal of Raptor Research 23:42–44.

Williams, C. S. 1938. Aids to the identification of mole and shrew hairs with general comments on hair structure and hair determination. Journal of Wildlife Management 2:239–250.

Workman, S. K. and K. W. McLeod. 1990. Vegetation of the Savannah River Site: major community types. SRO-NERP-19. Savannah River Ecology Laboratory, Aiken, South Carolina, USA.

Yahner, R. H., G. L. Storm, and A. L. Wright. 1986. Winter diets of vultures in southern Pennsylvania. Wilson Bulletin 98:157–160.

Yahner, R. H., G. L. Storm, and W. L. Thompson. 1990. Winter diets of vultures in Pennsylvania and Maryland. Wilson Bulletin 102:320–325.